



Welfare implications of upstream subsidy in the presence of countervailing duties under limited verifiability

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Abstract

This paper examines how a politically biased strategic export subsidy influences social welfare when an importing country imposes countervailing duties on imported goods if the subsidy is verified. Based on a simple model that integrates the political contribution provided by exporting firms and the verifiability problem of an export subsidy for the upstream firms within a vertically fragmented production process, this paper demonstrates that politically biased strategic export policies can deteriorate social welfare. Moreover, when it is more difficult to identify hidden government subsidies, welfare loss due to politically biased subsidy is increased. Interestingly, an importing country is not motivated to fully countervail the politically biased export subsidies when it is concerned about social welfare, including consumer surplus. These results provide an answer on why the conflicts over hidden subsidies are increasing with deepening fragmentation of exporting firms' production processes. In addition, the results imply that it is imperative to make further efforts to enhance the verifiability of the hidden subsidies in order to reduce the welfare deterioration caused by the politically biased strategic trade policies.

Keywords Strategic trade intervention · Political contribution · Verifiability of hidden subsidy · Begging thyself · Begging thy neighbor

JEL Classification F12 · F13 · L13 · L52

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1 Introduction

This paper examines how hidden government subsidies for exporting firms affect social welfare when the importing country imposes a countervailing duty. With the unprecedented progress of global market integration in recent decades, the intensifying cross-border competition within oligopolized industries has made government intervention to provide a strategic edge for domestic firms a prevalent feature. At the same time, fragmentation of global production networks has become a dominant corporate strategy with the sharp reduction in cross-border transaction costs. As a result, it has become much more difficult and complicated to identify government intervention in the production process within the fragmented production process (OECD 2010).

One of the factors that triggered the latest US–China trade war is the long-standing and deep-rooted suspicion about possible Chinese violations of the export-subsidy rules by means of hidden subsidies, citing Section 232 of the Trade Expansion Act. The disputed abuse of the Chinese government’s hidden subsidies granted to Chinese firms is closely related to this limited verifiability issue, since the subsidies are provided to the upstream production stages in the form of subsidized cheap prices of raw materials, energy, land, and components (Price et al. 2006). These upstream subsidies worked as indirect subsidies to downstream firms for their competitive edge in the foreign markets (Haley and Haley 2013; Lim et al. 2018). In addition, the OECD (2010) reported that “it is getting more difficult to identify the intervention since a wide variety of different instruments are used including direct subsidies, tax breaks or loan guarantees in the various stages of the production processes.”¹ The costly distortions caused by government subsidies include price distortion, productive inefficiency caused by capital misallocation, and the social cost of rent-seeking via politically manipulated subsidies.

In addition, increasing numbers of trade disputes are over the legality of subsidy—countervailing duties, which are heavily involved with the hidden export subsidy issues. Hidden subsidies are provided to upstream production within complicated, vertically fragmented production processes (Chiang 2017). Motivated by this background, we examine the welfare effects of the hidden export subsidies facing the countervailing duties of the importing countries, which are affected by the limited verifiability of the subsidy.

To resolve the international disputes over export subsidies, the WTO introduced a guideline based on the Agreement on Subsidies and Countervailing Measures (SCM Agreement). The purpose of countervailing duty investigation is to determine whether subsidized imports cause or threaten injury to a competing country’s industry. These investigations typically are conducted when an importing country’s industry submits a petition, along with supporting evidence, that alleges the existence of injurious subsidization. “Simple assertion, unsubstantiated by relevant evidence, cannot be considered” for the initiation and subsequent investigation. In response to the petition from the domestic industry, during a reasonable period of time, the importing country’s government is responsible for proving whether imports are subsidized. It can be harder for the importing country to prove the use of subsidies, especially

¹ See OECD (2010), Policy Roundtables: Competition, State Aids and Subsidies.

when the exporting country is engaged in covert subsidization. Thus, for the importing country, it is most critical to increase the verifiability of the subsidization by the exporting country.² (https://ustr.gov/archive/Document_Library/Press_Releases/2005/June/United_States_Wins_WTO_Semiconductor_Case.html).

Motivated by these backgrounds, we aim to examine the welfare implications of government subsidies that provide a strategic advantage to domestic firms, focusing on cases where the subsidy is offered to an upstream firm within a vertical production network. In addition, we evaluate the welfare effects of varying levels of verifiability of the subsidy given to the upstream firm within a complicated vertical production process.

The seminal papers by Brander and Spencer (1985) and Eaton and Grossman (1986) have shown that strategic trade policies can improve social welfare by providing strategic advantage, i.e., the Stackelberg leadership advantage, to domestic firms as long as the competing government does not take equivalent or countervailing policy measures. Nonetheless, strategic trade policies result in the deterioration of social welfare when the policies are manipulated with political contributions even if the competing government takes no action (Kagitani 2009; Fung et al. 2009).

Kagitani (2009) is closely related to this paper, in that both papers examine the welfare effects of strategic trade policies influenced by political contributions. Kagitani (2009) focused on the mode of oligopolistic competition, showing that the politically biased trade policy in Bertrand competition over heterogeneous products deteriorates the net social welfare more than does Cournot competition over homogeneous products. In contrast, we introduce the countervailing duty imposed by the importing country when the subsidy can be verified. Moreover, we extend the discussion by integrating the informational issues caused by hidden subsidies provided to the upstream firms within vertically fragmented production process. Considering the role of countervailing duties and informational barriers, we demonstrate that the limited verifiability of the subsidy aggravates the welfare loss caused by the politically biased trade policies. Just as the higher political weight of contribution worsens social welfare, mainly because of the higher amount of contribution, we show that the lower verifiability of subsidy worsens social welfare because of the increase in the subsidy expenditure, which is larger than is the increase in the subsidized firm's profit. Focusing on the effects of various levels of the verifiability of the hidden subsidies, we demonstrate the importance of the increased transparency and systemized informational disclosure of trade policies, which was not addressed in the earlier literature.

Bagwell and Staiger (2006) analyze and compare the rules on subsidies under the GATT and WTO regimes. They argue that subsidy rules additionally imposed in the WTO regime might bring about undesirable consequences, in that overly strict regulation against subsidies can reduce welfare because of the limited availability of policy tools. The study is along the lines of the research that discusses the possible limitations of the current WTO subsidy rules (Sykes 2005, 2010; Horlick and Clarke 2017). Meanwhile, Brou and Ruta (2013) and Lee (2016a, b) acknowledged the positive contribution of the WTO rules on subsidies when they show how the optimal design of the

² In the case of the USA, "The US Department of Commerce is responsible for determining whether imports are subsidized, while the US International Trade Commission (USITC) is responsible for determining whether subsidized imports cause or threaten injury."

subsidy rule under GATT/WTO affects domestic subsidies within trade agreements. Questioning the efficiency of the SCM agreement, we show that upstream subsidization by the exporting country cannot be fully prevented under the current SCM rules. This paper is also related to a strand of literature about the welfare effect of countervailing duties (Grossman 1986; Dixit 1988; Collie 1991). Spencer (1988) examines certain conditions under which the countervailing duty can offset the capital subsidy. In a similar context, Ishikawa and Komoriya (2007) study the effects of capital subsidy, export subsidy, and countervailing duty when there are cost asymmetries between subsidized firms.

We set up a simple oligopoly model where representative firms from two countries compete a la Cournot fashion based on intermediate goods provided by the upstream firms of each country. The domestic government considers strategic trade policies that are politically biased by the political contributions made by domestic firms that can influence the policies. Therefore, the corporate sectors' political contribution schedule can actually influence and design government policies, since the policymaker's appreciation for the political contributions is known to the corporate sectors. Moreover, we consider the limited verifiability of the subsidy provided to the upstream firms within complicated vertical production networks. Based on the model, we demonstrate that strategic export policies influenced by political contributions can worsen social welfare.

Moreover, when it is more difficult to identify the government subsidies provided to upstream firms within complicated vertical value chains, there is larger distortion because of higher export subsidies manipulated by political contributions. Therefore, even if countervailing duties are imposed against the export subsidies, the export subsidy dominates the countervailing duty with the distortion caused by the political contributions and aggravated by the lower detection probability. These results imply that, with the deepening fragmentation of global production networks, as it gets more difficult to verify the subsidies given to upstream production processes, it is more likely that indirect and hidden strategic government interventions can be made. Therefore, it is imperative to make further efforts to increase the verifiability of hidden subsidies in order to reduce how much welfare is worsened because of politically manipulated strategic trade policies.

This paper is structured as follows. Section 2 discusses the benchmarking model and the features of equilibrium without political contributions in the exporting country. Section 3 examines the equilibrium where political contributions are made by the exporting firms to influence the government policies. Section 4 evaluates the welfare effects of political contributions in the strategic trade policies with varying levels of verifiability of the subsidy provided to the upstream firms. Section 5 discusses the policy implications and concludes.

2 Benchmarking discussions: equilibrium without political contributions in the exporting country

There are two countries: an exporting country and an importing country. In the exporting country, there are an upstream firm (firm u) and a downstream firm (firm 1) that produce a good and export it to the importing country. In the importing country, there is a local firm (firm 2) that serves the domestic market. In the importing country, firm 1 and firm 2 compete a la Cournot fashion. A representative consumer in the importing country has a quasi-linear preference. Good b , a numeraire good, is a perfectly competitive good. The utility function of the consumer is given as follows:

$$U(q_1, q_2, z) = aq_1 + aq_2 - q_1^2/2 - q_2^2/2 + z, \quad a > 0 \quad (1)$$

where q_1 and q_2 are the consumption of goods 1 and 2, respectively.

From the utility maximization, we obtain the following inverse demand functions for goods 1 and 2 as $p_i = a - q_i - q_j$ for $i, j = 1, 2$ and $i \neq j$.

The profit of the downstream firm π_1 , the profit of the upstream firm π_u , and the profit of the foreign firm π_2 are, respectively, as follows:

$$\pi_1 = (p_1 - m)q_1 = (a - q_1 - q_2 - m)q_1 \quad (2)$$

$$\pi_2 = (p_2 - c)q_2 = (a - q_2 - q_1 - c)q_2 \quad (3)$$

$$\pi_u = (m - c_u + s)q_1 = (m - c + s)q_1 \quad (4)$$

where m is the price of the intermediate good, c_u is the unit cost of producing the intermediate good that is equal to c , and firm 2 purchases the intermediate good at a cost of c from the local market. To produce one unit of the final good, one unit of the intermediate good is required (Lin and Saggi 2007). We assume that the upstream firm in the exporting country does not provide the intermediate good to firm 2 in the importing country. The government of the exporting country provides the upstream firm with the production subsidy s . To focus on the strategic effects of subsidies, c is assumed to be sufficiently low, that is, $c = 0$.

The importing country can request a WTO panel in challenging the exporting country's subsidy practice. The WTO panel can verify the subsidy with the probability $\mu \in [0, 1]$, and then the countervailing duties will be enforced; the importing country will impose a countervailing duty against the subsidized good made in the exporting country. With probability $1 - \mu$, however, the importing country will not impose any countervailing duties, because of the failure to verify the case.

The model is structured as a four-stage game. In stage 1, the exporting government sets its production subsidy. In stage 2, taking the production subsidy as given, the upstream firm chooses a profit-maximizing price for the intermediate good provided to firm 1. In stage 3, the importing country's government challenges the legitimacy of the production subsidy according to the WTO SCM agreement.³ The WTO panel can

³ The WTO rule on the subsidy-countervailing measure (SCM) goes as follows: "Importing countries might be allowed to take countervailing measures such as duties against specific subsidies provided by the

prove the exporting country's practice of the production subsidy with the probability μ , in which case the foreign government will be authorized to retaliate by choosing countervailing duties on the imports. With the probability $1 - \mu$, the panel cannot prove the use of the production subsidy, in which case the foreign country will not impose countervailing duties on the imports. In stage 4, if the upstream subsidy is verified (not verified), the importing country sets an optimal countervailing duty (zero duty) on the subsidized good, and firm 1 and firm 2 compete a la Cournot fashion. The solution concept of the game follows subgame perfect Nash equilibrium.

2.1 Upstream subsidy, countervailing duties, and verifiability

When a production subsidy for the upstream firm is unverifiable, in the fourth stage of the game, firm 1 and firm 2 maximize profits by choosing their quantity. Solving for the Cournot–Nash equilibrium quantities, we obtain the equilibrium quantities, q_{1n} and q_{2n} , and the equilibrium profits, π_{1n} and π_{2n} , when an upstream subsidy is non-verified as:

$$q_{1n}(m) = (a - 2m)/3, q_{2n}(m) = (a + m)/3 \quad (5)$$

$$\pi_{1n}(m) = (a - 2m)^2/9, \pi_{2n}(m) = (a + m)^2/9 \quad (6)$$

The quantities and the profits of the two firms, in the equilibrium, are described as a function of the price of the intermediate good m that depends on the level of subsidy s provided to the upstream firm. However, if the exporting country's subsidy is verified by the WTO panel, the importing country will impose a countervailing duty, f , on the imported goods:

$$\pi_1 = (p_1 - m)q_1 = (a - q_1 - q_2 - m - f)q_1$$

After observing both the intermediate good price and a countervailing duty, however, firm 1 and firm 2 choose profit-maximizing output levels. We obtain the equilibrium quantities, q_{1v} and q_{2v} , and the equilibrium profits, π_{1v} and π_{2v} , when the subsidy is verified as:

$$q_{1v}(m, f) = (a - 2f - 2m)/3, q_{2v}(m, f) = (a + f + m)/3 \quad (7)$$

$$\pi_{1v}(m, f) = (a - 2f - 2m)^2/9, \pi_{2v}(m, f) = (a + f + m)^2/9 \quad (8)$$

Footnote 3 continued

exporting country to export-related industries when such subsidies have caused significant damages to the importing country's industries." (Part IV of SCM Agreement, WTO: https://www.wto.org/english/tratop_e/scm_e/subs_e.htm).

The importing country chooses the countervailing duty that maximizes the country's welfare within the range allowed by the WTO rules, and firm 1 chooses the optimal quantity that maximizes its profits net of f as⁴:

$$\text{Max}_f \text{SW}_2 = \text{CS}_2 + \text{PS}_2 + \text{GR}_2 \quad (9)$$

where $\text{CS}_2 = U(q_{1v}, q_{2v}, z) - pq_{1v} - pq_{2v}$ and $\text{PS}_2 = (a + f + m)^2/9$, $\text{GR}_2 = fq_{1v}$.

Substituting (7) and (8) into (9) and taking the derivative of (9) with respect to f gives the optimal countervailing duty as:

$$f^* = (2a - 4m)/11 \quad (10)$$

As shown in (10), the optimal countervailing duty is more sensitive to the price of the intermediate good relative to a market size, and the importing country government sets a higher countervailing duty when a lower price of intermediate goods is observed.

Next, consider the third stage of the game, in which the importing country challenges the validity of the exporting country's production subsidy under the SCM agreement. With the probability μ , the WTO panel verifies the exporting country's practice of the production subsidy, in which case the foreign government will be authorized to retaliate by imposing a countervailing duty on the imports. With the probability $1 - \mu$, the panel fails to prove the use of the subsidy, and in that case, the importing country will not impose the countervailing duty.

In stage 2, the upstream firm sets a profit-maximizing price for the intermediate good, taking into account the demand for the intermediate good that is derived from the expected demand of the final good $E[q_1(m, \mu)]$. Based on the derived demand, the upstream firm seeks to maximize its profits with respect to the intermediate price (Goh 2005; Lin and Saggi 2007):

$$\text{Max}_m E[\pi_u] = (m + s)E[q_1(m, \mu)] \quad \text{where } E[q_1(m, \mu)] = (1 - \mu)q_{1n}(m) + \mu q_{1v}(m)$$

Taking the first derivative of the expected demand with respect to the probability, we obtain $\partial E[q_1(m, \mu)]/\partial \mu < 0$, since $q_{1n}(m) > q_{1v}(m)$. From the maximization problem, we obtain the optimal intermediate price and the optimal profits as:

$$m(s) = a/4 - s/2, \quad E[\pi_u(s, \mu)] = (m(s) + s)E[q_1(u(s), \mu)] \quad (11)$$

⁴ "Material injury" is a key concept when the importing country/WTO sets countervailing duties. According to the "Antidumping and countervailing duty handbook (2015)" released by the US International Trade Commission, material injury includes not only "(1) the volume of imports of the subject merchandise, (2) the effect of imports of that merchandise on prices in the USA for domestic like products, and (3) the impact of imports of such merchandise on domestic producers of domestic like products in the context of production operations within the USA, but also (4) actual and potential declines in output, sales, market share, profits, productivity, return on investments, and utilization of capacity; (5) factors affecting domestic prices; (6) actual and potential negative effects on cash flow, inventories, employment, wages, growth, ability to raise capital, and investment; (7) actual and potential negative effects on the existing development and production efforts of the domestic industry, including efforts to develop a derivative or more advanced version of the domestic like product." This very wide-ranging definition of material injury made by the US government is often criticized as the source of the US government's arbitrary abuse of subsidy-countervailing duties.

The effect of the production subsidy s on the intermediate good price is given as: $\partial m(s)/\partial s < 0$. Using the envelope theorem, we show that the production subsidy has a positive effect on the upstream firm’s profits as: $\partial E[\pi_u(s, \mu)]/\partial s > 0$. The comparative statics also show that the high verifiability reduces the upstream firm’s profit as:

$$\partial E[\pi_u(s, \mu)]/\partial \mu = -(m(\mu) + s)(q_{1n}(m) - q_{1v}(m)) < 0.$$

We summarize the result in Lemma 1.

Lemma 1 *Subsidy to the upstream firm lowers the intermediate good’s price and makes the downstream firm more competitive in the foreign market.*

The subsidy provided to the upstream firm has a spillover effect to the downstream firm by reducing the downstream firm’s marginal production cost by $s/2$. We call it a pass-by means of the effect of the upstream subsidy. By virtue of the upstream subsidy, the upstream firm provides the intermediate good to firm 1 at a lower price, which induces firm 1 to improve its export performance, thereby increasing demand for the intermediate good. As a result, firm u can achieve higher profits. Second, the probability of the verification reduces the upstream firm’s profits. When the probability gets higher, firm 1 produces less, so that the expected demand for the intermediate good goes down, leading to a reduction in the profits of the upstream firm.

Let SW_1 represent the social welfare of the home country. In stage 1, the home government chooses the optimal level of the subsidy s to maximize the social welfare:

$$\text{Max}_s SW_1 = E[\pi_u(s)] + (1 - \mu)E[\pi_{1n}(s)] + \mu E[\pi_{1v}(s)] - s((1 - \mu)q_{1n}(s) + \mu q_{1v}(s))$$

From the welfare maximization problem, the equilibrium subsidy and the optimal social welfare are obtained as:

$$s_c^*(\mu) = \frac{a(1331 - 1276\mu + 288\mu^2)}{(11 - 4\mu)(121 + 12\mu)} = \frac{a(121 - 72\mu)}{(121 + 12\mu)}, SW_1^* = SW_1(s_c^*(\mu)) \quad (12)$$

The exporting country sets a positive production subsidy for the upstream firm that is passed through to the downstream firm. The optimal amount of the production subsidy is obtained as the subgame perfect outcome of the four-stage game. Next, substituting the optimal subsidy into (11) gives the optimal price of the intermediate good and profits of the upstream firm. We obtain the optimal countervailing duty by substituting the optimal price of the intermediate good into (10).

Last of all, substituting the optimal price of the intermediate good and the countervailing duty into (5), (6), (7), and (8) gives the equilibrium quantities and profits. The comparative statics of the equilibrium produce the results summarized in Proposition 1.

Proposition 1 *As the verifiability gets lower, (a) the government of the exporting country provides a higher level of subsidy, (b) the upstream firm sets a lower price of the intermediate good, (c) the government of the importing country imposes a higher level of a countervailing duty, and (d) the social welfare of the exporting country increases and the social welfare of the importing country decreases.*

The proof is in [Appendix A](#). Proposition 1 shows that when the probability of verifying the subsidy decreases, the exporting country increases the production subsidy, which reduces the price of the intermediate good. In response to this, the importing country prepares a strong countervailing measure to protect its local firm from competing with the exporting firm that is indirectly subsidized by means of the intermediate good price. The result implies that a lower probability leads to “the more subsidy, the stronger the countervailing duties,” which results in a greater market distortion.

3 Equilibrium with political contribution in the exporting country

Consider a political game in which a production subsidy for the intermediate good is set by means of the strategic interaction between firm 1 and the exporting country’s government. Firm 1 may exert influence on a political process through political contributions. In exchange for the contributions, the firm obtains a production subsidy in the indirect way; the upstream firm receives the production subsidy passed through to the downstream firm. The incumbent policymaker tries to keep political power by maintaining reputation and popularity by means of campaign spending funded by the political contribution.

Accordingly, the exporting country’s government is concerned with the political donations received from the home downstream firm, C_p , as well as the level of social welfare, $SW(s)$. Let $SW(s) - C_p$ represent the net social welfare of the country. Accordingly, the government’s objective function will take a form similar to that in Grossman and Helpman (1994):

$$G(s) = SW(s) + (\theta - 1)C_p$$

where θ is the weight that the home country’s government places on the political contributions. There is no restriction on the political contribution. If $\theta > 1$, political contributions provide positive utility to the policymaker, and if $\theta > 2$, the government pays more attention to the contributions, with a heavier weight on political contributions than on general voters’ welfare.

The model is structured as a five-stage game. The timing of the game is as follows. In stage 1, firm 1 offers the exporting country’s government a campaign contribution schedule as a function of the subsidy provided by the government. In stage 2, the government sets its production subsidy, taking the contribution schedule as given. In stage 3, taking the production subsidy as given, firm u chooses a profit-maximizing price for the intermediate good supplied to firm 1. In stage 4, the importing country’s government challenges the legitimacy of the production subsidy under WTO SCM agreement. In stage 5, if the upstream subsidy is verified (not verified), the importing country sets an optimal countervailing duty (zero duty) on the subsidized good, and firm 1 and firm 2 compete a la Cournot fashion. Stage 3 in Sect. 3 corresponds to stage 2 in Sect. 2, stage 4 in Sect. 3 corresponds to stage 3 in Sect. 2, and stage 5 in Sect. 3 corresponds to stage 4 in Sect. 2. The solution concept of the game follows subgame perfect Nash equilibrium.

3.1 Upstream subsidy, countervailing duties, and verifiability with political contributions

In stage 5, for a non-verifiable production subsidy for the upstream firm, after observing the intermediate good price, firm 1 and firm 2 maximize profits by choosing their quantities. The Nash quantities in the non-verifiable case are the same as (5) in Sect. 2. In the fifth stage of the game, however, if the exporting country’s subsidy is verified by the WTO panel, the importing country will impose a countervailing duty, f , on the imported goods. The Nash quantities in the non-verifiable case are the same as (7) in Sect. 2.

In stage 4, the importing country chooses the countervailing duty that maximizes the country’s welfare, which is the same as (10) in Sect. 2.

In stage 3, firm u chooses a profit-maximizing price for the intermediate good based on the expected demand for it. The optimal price in this section is the same as (11).

In stage 2, the government sets its optimal production subsidy, taking the contribution schedule as given. The home country’s government maximizes the political objective function consisting of the political contribution and the social welfare. The incumbent government chooses the optimal level of the subsidy to maximize its objective function, taking the political contribution schedule as given:

$$\begin{aligned} & \text{Max}_s \text{SW}_1(s) + (\theta - 1)C_p \\ & \text{where } \text{SW}_1 = E[\pi_u(s)] + (1 - \mu)E[\pi_{1n}(s)] + \mu E[\pi_{1v}(s)] - s((1 - \mu)q_{1n}(s) + \mu q_{1v}(s)) \end{aligned} \tag{13}$$

Note that when $\theta = 1$, the government becomes a benevolent social welfare maximizer that sets an optimal production subsidy for the domestic firms, since the political contribution is canceled out in the political objective function. The government chooses an optimal subsidy to maximize its objective function. The politically optimal subsidy satisfies the following first-order condition:

$$\frac{d\text{SW}_1(s)}{ds} + (\theta - 1)\frac{dC_p}{ds} = 0$$

Move to the first stage of the game. In our study, there exists only a single lobby. Grossman and Helpman (1996) examine a single-lobby case where one single-interest group announces its contribution schedule; after observing it, each party chooses a policy platform. The party may reject the schedule when it has a better option to maximize a fraction of votes. Thus, the single-interest group must consider the participation constraint that makes the party accept a contribution and induce a policy. Thus, we set up the first stage of this game, in which the downstream firm sets its optimal contribution schedule to maximize the net profit of the political contribution, taking into account the participation constraint of the government:

$$\begin{aligned} & \text{Max}_{c_p} (1 - \mu)E[\pi_{1n}(s)] + \mu E[\pi_{1v}(s)] - C_p \\ & \text{s.t. } \text{SW}_1(s) + (\theta - 1)C_p \geq \text{SW}_1^* \end{aligned} \tag{14}$$

The participation constraint will be binding, which implies the minimum size of the contribution. The contribution is described as a function of the subsidy that the downstream firm attempts to induce. Thus, as in Grossman and Helpman (1996), with the binding participation constraint, (14) is simplified to maximizing the net profits as:

$$(1 - \mu)E[\pi_{1n}(s)] + \mu E[\pi_{1v}(s)] - (SW_1^* - SW_1(s))/(\theta - 1).^5$$

The equilibrium subsidy that the government chooses satisfies:

$$(1 - \mu) \frac{dE[\pi_{1n}(s)]}{ds} + \mu \frac{dE[\pi_{1v}(s)]}{ds} + \frac{1}{\theta - 1} \frac{dSW_1(s)}{ds} = 0 \quad (15)$$

In the equilibrium, the optimal subsidy to maximize the net profits is equal to the subsidy that the government chooses. As $\theta \rightarrow 1$, the subsidy becomes one that maximizes the social welfare, but as $\theta \rightarrow \infty$, the subsidy maximizes only the profit of the downstream firm. All other subsidies existing between the two extreme values maximize the weighted sum of the profits and the social welfare. Consequently, we obtain the equilibrium subsidy under the political economy as:

$$s_p^*(\theta, \mu) = \frac{\theta a(1331 - 1276\mu + 288\mu^2)}{(11 - 4\mu)(363 - 165\mu - 2\theta(121 - 85\mu))}$$

The optimal subsidy becomes positive. Using the subsidy, we derive the optimal contribution. Next, substituting the optimal subsidy into (11) gives the optimal price of the intermediate good, profits of the upstream firm, and the optimal countervailing duty. Substituting the optimal price of the intermediate good and the countervailing duty into (5), (6), (7), and (8) gives the equilibrium quantities and profits of each firm.

Lemma 2 *The equilibrium subsidy provided to the upstream firm is increased when the government of the exporting country is influenced by political contributions.*

The proof is straightforwardly given as: $\partial s_p^*(\theta, \mu)/\partial \theta > 0$, which implies that the equilibrium subsidy is monotonically increasing in θ . Lemma 2 shows that the equilibrium subsidy with political contribution $s_p^*(\theta, \mu)$ is always larger than the equilibrium subsidy without political contribution $s_c^*(\mu)$ as long as $\theta > 1$. In Eq. (11), a higher upstream subsidy leads to a lower intermediate price, which implies that a pass-through effect of the upstream subsidy becomes greater under the political economy. As a result, the price of the intermediate good in the presence of the political contribution $m(s_p^*(\theta, \mu))$ is always lower than the intermediate good price in the absence of the contribution $m(s_c^*(\mu))$ if $\theta > 1$. Under the economy with the political contribution, because the exporting country's firm can purchase the intermediate good at a lower price, it takes a larger market share and achieves higher profits in the international market. On the other hand, the importing country's firm loses its market share and its profits because of the subsidy practiced by the exporting country. Consequently, the subsidy provides a strategic advantage to the domestic downstream firm (firm 1), making firm 1 more competitive while reducing the profits of firm 2.

⁵ For the details, refer to Proposition 1 in Grossman and Helpman (1996), which demonstrates that the equilibrium policy platform also maximizes the lobby's expected payoff.

Proposition 2 *When political contribution is allowed, as the probability of detecting the subsidy decreases, (a) a self-interested government increases the subsidy, (b) the upstream firm decreases the intermediate good price, (c) the foreign government sets a higher countervailing duty, and (d) the net social welfare of the exporting country is decreased.*

The proof is in [Appendix A](#). Proposition 2 shows that even if a political contribution is made by the exporting firm, as long as the political weight given to the political contribution is not extremely high, the lower subsidy-detection probability increases the level of the subsidy as well as the level of the countervailing duty and decreases the price of the intermediate good. This detection probability affects the participation constraint of the government as: $SW_1(s) + (\theta - 1)C_p \geq SW_1^*$.

As Proposition 1 explains, a lower detection probability leads to higher social welfare in the absence of the political contribution SW_1^* . Accordingly, the firm should provide a higher political contribution to make the government accept it and to induce a policy, which will reduce the net social welfare $SW_1(s) - C_p$.⁶ Consequently, a decrease in the detection probability lowers both the net social welfare of the exporting country and the social welfare of the importing country.

4 The welfare analysis of the political contribution in the strategic trade policies

Although a politically biased export subsidy might reduce the exporting country's welfare, as shown in the earlier section, this section examines how the politically biased subsidies might influence the importing country's welfare and the possible policy responses of the importing country that can react with the countervailing duties. From the comparison of each equilibrium given a political contribution or no political contribution, the welfare implications of the political contribution by the exporting firm are as follows.

Lemma 3 *Comparing the outcomes in the presence of lobbying with the case without lobbying, we obtain:*

- (a) $E[\pi_1(s_p^*(\theta, \mu)) - C_p] > E[\pi_1(s_c^*(\mu))]$,
- (b) $E[\pi_2(s_p^*(\theta, \mu))] < E[\pi_2(s_c^*(\mu))]$,
- (c) $E[\pi_u(s_p^*(\theta, \mu))] > E[\pi_u(s_c^*(\mu))]$,
- (d) $s_p^*(\theta, \mu)E[q_1(s_p^*(\theta, \mu))] > s_c^*(\mu)E[q_1(s_c^*(\mu))]$.

From Lemma 3, the upstream firm and the downstream firm become more profitable under the regime with a political contribution than under one without it. That is, firms in the exporting country prefer to offer their government political contributions in exchange for an upstream subsidy. In contrast, the import country's firm is damaged by the higher subsidy manipulated by the political contribution.⁷

⁶ Grossman and Helpman (1994) define gross-of-contribution welfare as the summation of the aggregate income, consumer surplus, and government surplus, including the political contribution. Therefore, net social welfare is defined as being less than the gross social welfare by the amount of the political contribution.

⁷ See the details in [Appendix C](#).

Proposition 3 (a) *The net social welfare, i.e., the general voter's welfare, with the political contributions of the exporting firm, is always lower than the one without the contribution.* (b) *As well, the upstream subsidization leads to a beggar-thyself case when the government is more heavily influenced by the political contribution with a higher θ .*⁸ (The proof is in [Appendix B](#)).

From Lemma 3, we find that the profits for the downstream firm and the upstream firm of the exporting country are higher when a political contribution of the firm is allowed than in the case without political contribution:

$$E[\pi_1(s_p^*(\theta, \mu)) - C_p] > E[\pi_1(s_c^*(\mu))] \text{ and } E[\pi_u(s_p^*(\theta, \mu))] > E[\pi_u(s_c^*(\mu))].$$

The political contribution makes the subsidy provided by the government of the exporting country excessively high:

$$s_p^*(\theta, \mu)E[q_1(s_p^*(\theta, \mu))] > s_c^*(\mu)E[q_1(s_c^*(\mu))].$$

Therefore, the net social welfare with a political contribution is lower than in the case without political contribution, with the social loss from the excessively high subsidy dominating the corporate gains. This result shows that the politically motivated export subsidy can actually deteriorate net social welfare with the upwardly distorted trade policies. In addition, the domestic net social welfare drops when the government is more politically motivated in deciding on the upstream subsidy. Consequently, the politically motivated government might end up with a *beggar thyself policy* in terms of net social welfare (Stiglitz 1999; Fatum et al. 2018).

Proposition 4 *The upstream subsidization does not lead to a beggar-thy-neighbor case when the government is more heavily influenced by the political contribution with a higher θ .*

The proof is provided in [Appendix B](#). Proposition 4 shows that the upstream subsidization of the exporting country does not result in worsening the welfare of the foreign country. Proposition 4 shows that the social welfare of the foreign country when the government of the exporting country is politically motivated, $SW_2(\theta, \mu)$, is always higher than the foreign social welfare when the government of the exporting country is not politically motivated, $SW_2(\mu)$. Moreover, the foreign social welfare is improved with the higher θ , since a positive effect of θ on foreign consumer surplus

⁸ As long as the government decision making on the subsidy policy is influenced by the political contribution with $\theta > 1$, we can say that the government is more heavily influenced by the political contribution when the value of θ is higher, which represents that the policy weight given to the contribution provided by the corporate sector is higher. Part (a) of Proposition 3 shows that the politically biased export subsidy lowers the social welfare more than in the case where the subsidy is not politically biased, comparing the equilibrium social welfares of the two cases. On the other hand, part (b) of Proposition 3 digs into the details of the case where the export subsidy is politically biased, focusing on the effect of various levels of political weight given to the political contribution, C_p^* , in the policymaking process. "Beggar-thyself policies" are defined as "policies whose economic costs are borne primarily at home, though they might affect others as well" by Rodrik (2012), and in the same context, the terminology is used as self-damaging policies mainly caused by the deadweight loss caused by price distortion and aggravated by the politically biased export subsidy policies. Since "beggar-thyself policies" have self-inflicted effects, "beggar-thy-neighbor" policies cause one-sided benefits while imposing damages on the neighboring countries, mainly through extracting rents from neighboring countries.

and foreign government surplus overrides its negative effect on the foreign producer surplus.

A higher political weight on the political contribution, θ , results in a higher subsidy of the exporting country, which induces the exporting firm to produce more products at cheaper prices, improving the consumer surplus of the foreign country. The government surplus of the importing country is also improved with the higher θ when the detectability of the upstream subsidy, μ , is positive, which implies that the importing country might be better off when the government of the exporting country is more politically motivated to subsidize her upstream firms. Thus, remarkably, when the government of the exporting country is strongly politically motivated, the upstream subsidization in favor of its domestic firm might not be a *beggar-thy-neighbor*-type policy.

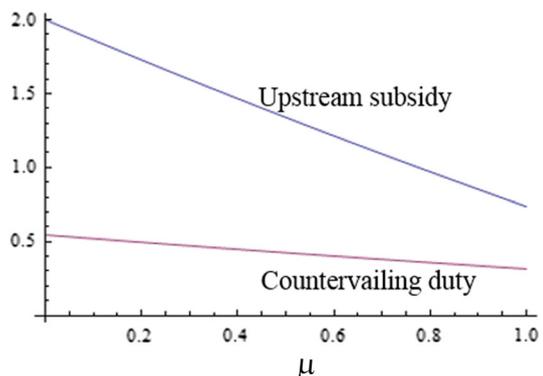
Proposition 5 *The level of the optimal subsidy provided by the exporting country is always higher than the level of the countervailing duty. When the probability of verifying the subsidy, μ , is higher, the upward subsidy distortion under the political contribution is reduced.*

Proof See [Appendix B](#).

Proposition 5 shows that the level of the upstream subsidy is higher than the level of the countervailing duty as shown in Fig. 1. In the comparison of export subsidy and countervailing duty, it turns out that the countervailing duty does not fully remedy the price distortion caused by the exporting subsidy. The intuition behind this result is that the exporting country that provides the upstream subsidy plays as a first mover in the game and extracts “first mover advantage.” When it provides the subsidy, it already takes into account the optimal countervailing action by the importing country that plays as a second mover. In this sense, the imposition of the countervailing duty is not strong enough to remedy the distortion caused by the subsidy provided to the upstream firm.

Moreover, when the importing country’s government is not politically manipulated by political contributions as assumed in this paper, the importing country’s government has no incentive to fully countervail the subsidy provided to the upstream firm of the

Fig. 1 Upstream subsidy and countervailing duty changes relative to detection probability



exporting country, since the social welfare of the importing country is improved by the exporting country's subsidy policy, as discussed before. As a result, the equilibrium countervailing duty imposed by the importing country is lower than the equilibrium subsidy, as shown in Proposition 5.⁹

A higher detection rate makes the level of the upstream subsidy similar to that of the countervailing subsidy. The difference between the subsidy and the countervailing duty is larger as detection probability is lower. The amount of the subsidy and the countervailing duty is decreased with the probability to verify the subsidy:

$$\partial s_p^*(\theta, \mu)/\partial \mu < 0 \text{ and } \partial f^*(\theta, \mu)/\partial \mu < 0.$$

Since $\|\partial s_p^*(\theta, \mu)/\partial \mu\| \geq \|\partial f^*(\theta, \mu)/\partial \mu\|$, the countervailing duty is getting closer to the subsidy level with increasing detection probability. The welfare loss because of the upward distortion of subsidies via political contributions can be reduced by introducing increased transparency in the trade policies involved with vertically integrated industrial structures.¹⁰

Proposition 5 also shows that when it is more difficult to detect the upstream subsidy, the exporting country's government has an incentive to provide a higher subsidy with the limited effectiveness of countervailing duty, whereas the difference between the subsidy and the countervailing duty gets lower when the probability of verifying the upstream subsidy becomes higher.¹¹

⁹ Moreover, when it is more difficult to identify hidden government subsidies, welfare loss caused by a politically biased subsidy is increased. Interestingly, an importing country is not motivated to fully countervail the politically biased export subsidies when it is concerned about social welfare, including consumer surplus.

¹⁰ Proposition 4 shows that the welfare of the importing country is not worsened by the upstream subsidization of the exporting country. In addition, the findings in Proposition 5 tell us that the export subsidies provided by the exporting country cannot be fully countervailed under current WTO rules. These results might imply that the importing country does not have the incentive to increase the verifiability to fully countervail the subsidies provided by the exporting country, and the current WTO rules are ineffective in fully countervailing the subsidies. Then, the policy implication that "enhancing transparency can reduce the welfare loss caused by the upward distortion from subsidies" might sound irrelevant given the findings in Propositions 4 and 5, as noted by an anonymous reviewer. The importing country has indeed no incentive to increase the verifiability because of the consumers' gains from the subsidy if it is concerned with net welfare maximization. However, the welfare loss suffered by the exporting country because of the upward distortion of the export subsidy overrides the gain by the consumers in the importing country caused by the upwardly distorted subsidies, as straightforwardly shown in the welfare comparison in the Proofs of Propositions 3 and 4. Therefore, the welfare loss, i.e., the global welfare loss, caused by the upwardly distorted subsidies can be reduced by increased transparency in trade policies, as is consistent with an anonymous reviewer's interpretation that "distortive subsidy policies would persist in the absence of a mechanism that ensures transparency of subsidy policies." The reviewer's very insightful discussions and interpretation are deeply appreciated.

¹¹ The result of this paper, as shown in Propositions 4 and 5, that the equilibrium level of the countervailing duty imposed by the importing country is lower than the subsidy level implies the limitation of the current WTO rules for prohibiting export subsidies if the importing country's policymaker tries to maximize its social welfare, including consumer surplus. As demonstrated in Proposition 5, if the export subsidy does not damage the competitive environment of the importing country, the importing country is not motivated to fully countervail the export subsidy or prohibit the subsidy from the social welfare maximization perspective. This result supports the conjecture that the majority of the real world subsidy-countervailing measures are driven by the protective motivation, unless there is explicit evidence that the subsidized imported goods

5 Policy implications and concluding remarks

Considering the latest feature of deepening fragmentation and complicated vertical production networks, we examined the welfare effects of strategic subsidies to upstream firms affected by political contributions of exporting firms with limited verifiability of the subsidy because of the complicated vertical structures. Based on a simple model integrating political contributions provided by exporting firms and the verifiability problem of an export subsidy to upstream firms within an intricately fragmented production process, we have demonstrated that strategic export policies influenced by political contribution can worsen net social welfare. Moreover, when it is more difficult to identify the government subsidy to upstream firms within complicated vertical value chains, there is a larger distortion because of higher export subsidies influenced by the political contributions. Therefore, even if a countervailing duty is imposed against the export subsidy, when the probability of detecting the export subsidy is lower, the export subsidy overrides the countervailing duty with the distortion caused by political contributions and aggravated by the lower detection probability.

The results show that when the verifiability of subsidies provided to upstream firm is low, the optimal subsidy level is much higher than are the maximum countervailing duties imposed by importing countries, thus providing higher incentives for abuses of politically manipulated trade policies. Therefore, as it gets more difficult to verify the subsidy provided to upstream production processes, indirect and hidden strategic government interventions become more likely. The results imply that it is imperative to make coordinated efforts to increase trade policy transparency, especially with the involved vertically integrated industrial structures, in order to reduce the welfare distortion caused by the politically manipulated trade policies. Designing a mechanism for the concrete path to increase the verifiability would be a task for future studies, including institutional arrangements to improve the verifiability of specific government interventions.

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Footnote 11 continued

damage the competitive market conditions. Therefore, we recommend that WTO rules to prohibit export subsidies should be complemented with a more structured procedure for evaluating the market-disturbing effects of subsidized imports, focusing not just on the damages of import competing industries, but also on damages to the competitive environment.

Appendix A

Proof of Proposition 1 Proof is straightforwardly given as follows:

$$s_c^*(\mu) = \frac{a(1331 - 1276\mu + 288\mu^2)}{(11 - 4\mu)(121 + 12\mu)} = \frac{a(121 - 72\mu)}{(121 + 12\mu)}$$

$$\frac{\partial s_c^*(\mu)}{\partial \mu} = -\frac{10,164a}{(121 + 12\mu)^2} < 0, \quad \frac{\partial E[m(s_c^*(\mu))]}{\partial \mu} = \frac{5082a}{(121 + 12\mu)^2} > 0, \quad \frac{\partial E[f^*(\mu)]}{\partial \mu} = -\frac{88,704a}{(121 + 12\mu)^3} < 0$$

$$\frac{\partial SW_1}{\partial \mu} = -\frac{a^2(11 - 4\mu)(275 + 12\mu)}{2(121 + 12\mu)} < 0, \quad \frac{\partial SW_2}{\partial \mu} = \frac{a^2(11 - 4\mu)(27951 - 4\mu(1441 + 4\mu(263 + 12\mu)))}{4(121 + 12\mu)^3} > 0.$$

Proof of Proposition 2 Proof is straightforwardly given as follows:

$$\frac{\partial s_p^*(\mu, \theta)}{\partial \mu} = -\frac{10,164a\theta}{(363 - 132\mu - 2\theta(121 - 72\mu))^2} < 0, \quad \frac{\partial E[m(s_p^*(\theta, \mu))]}{\partial \mu} = \frac{5082a\theta}{(363 - 132\mu - 2\theta(121 - 72\mu))^2} > 0, \quad \frac{\partial E[f(s_p^*(\theta, \mu))]}{\partial \mu} = -\frac{1848a\theta}{(363 - 132\mu - 2\theta(121 - 72\mu))^2} < 0,$$

$$\frac{\partial SW_1(s_p^*(\theta, \mu))}{\partial \mu} = -\frac{a^2(11 - 4\mu)(A - 32\theta^2 B + 8\theta C)}{4(363 - 132\mu - 2\theta(121 - 72\mu))^3} > 0 \text{ since } A = -33(11 - 4\mu)^2(79 + 4\mu),$$

$$B = (1331 - 2970\mu + 1296\mu^2), \text{ and } C = (41261 - 37840\mu + 9472\mu^2 + 288\mu^3)$$

where the condition in the denominator, $363 - 132\mu - 2\theta(121 - 72\mu) > 0$, should be required for the nonnegative demand condition for firms in both countries.

We obtain $\frac{s_p^*(\theta, \mu)}{s_c^*(\mu)} = \frac{\theta(121 + 12\mu)}{363 - 132\mu - 2\theta(121 - 72\mu)} \geq 1$ that the equilibrium subsidy provided to the upstream firm is higher when the government of the exporting country receives political contributions than when it does not. We obtain the intermediate good price in each model as: $E[m(s_c^*(\mu))] = a/4 - s_c^*(\mu)/2$ and $E[m(s_p^*(\theta, \mu))] = a/4 - s_p^*(\theta, \mu)/2$. Then, $E[m(s_p^*(\theta, \mu))] < E[m(s_c^*(\mu))]$ since $s_p^*(\theta, \mu) > s_c^*(\mu)$.

- Proof of Lemma 3** (a) $E[\pi_1(s_p^*(\theta, \mu)) - C_p]$ is increasing in θ while $E[\pi_1(s_c^*(\mu))]$ is unrelated to θ . $E[\pi_1(s_p^*(\theta, \mu)) - C_p] = E[\pi_1(s_c^*(\mu))]$ if $\theta = 1$. If $\theta > 1$, $E[\pi_1(s_p^*(\theta, \mu)) - C_p] > E[\pi_1(s_c^*(\mu))]$ always holds.
- (b) $E[\pi_2(s_p^*(\theta, \mu))]$ is decreasing in θ while $E[\pi_2(s_c^*(\mu))]$ is unrelated to θ . $E[\pi_2(s_p^*(\theta, \mu))] = E[\pi_2(s_c^*(\mu))]$ if $\theta = 1$. If $\theta > 1$, $E[\pi_2(s_p^*(\theta, \mu))] < E[\pi_2(s_c^*(\mu))]$ always holds.
- (c) $E[\pi_u(s_p^*(\theta, \mu))]$ is increasing in θ while $E[\pi_u(s_c^*(\mu))]$ is unrelated to θ . $E[\pi_u(s_p^*(\theta, \mu))] = E[\pi_u(s_c^*(\mu))]$ if $\theta = 1$. If $\theta > 1$, $E[\pi_u(s_p^*(\theta, \mu))] > E[\pi_u(s_c^*(\mu))]$ always holds.
- (d) The result is definite since $s_p^*(\theta, \mu) > s_c^*(\mu)$ and $E[q_1(s_p^*(\theta, \mu))] > E[q_1(s_c^*(\mu))]$ when $\theta > 1$. □

Appendix B

Proof of Proposition 3 (a) In the equilibrium, the participation constraint of the government will be binding as: $SW_1(s_p^*(\theta, \mu)) + (\theta - 1)C_p(s_p^*(\theta, \mu)) = SW_1^*(s_c^*(\mu))$. Thus, $SW_1(s_p^*(\theta, \mu)) - C_p(s_p^*(\theta, \mu)) < SW_1^*(s_c^*(\mu))$ always holds. Specifically, according to Lemma 3, $SW_1(s_p^*(\theta, \mu)) - C_p(s_p^*(\theta, \mu)) - SW_1^*(s_c^*(\mu)) < 0$. This follows from the fact as:

$$\begin{aligned}
 & SW_1(s_p^*(\theta, \mu)) - C_p(s_p^*(\theta, \mu)) - SW_1^*(s_c^*(\mu)) \\
 &= \underbrace{E[\pi_1(s_p^*(\theta, \mu))] - C_p}_{+} - \underbrace{E[\pi_1(s_c^*(\mu))] + E[\pi_2(s_p^*(\theta, \mu))] - E[\pi_2(s_c^*(\mu))]}_{+} \\
 & \quad + \underbrace{s_p^*(\theta, \mu)E[q_1(s_p^*(\theta, \mu))] - s_c^*(\mu)E[q_1(s_c^*(\mu))]}_{-} > 0.
 \end{aligned}$$

(b) In addition, in the equilibrium, we obtain the value of the politically weighted social welfare $SW_1(s_p^*(\theta, \mu)) + (\theta - 1)C_p(s_p^*(\theta, \mu)) = a^2(11 - 4\mu)^2 / (968 + 96\mu)$. Taking the first derivative of it with respect to θ must be zero, as follows:

$$\frac{\partial SW_1(s_p^*(\theta, \mu))}{\partial \theta} + (\theta - 1) \frac{\partial C_p(s_p^*(\theta, \mu))}{\partial \theta} + C_p(s_p^*(\theta, \mu)) = 0$$

Rearranging it, since $C_p(s_p^*(\theta, \mu))$ is increasing in θ , we have

$$\frac{\partial SW_1(s_p^*(\theta, \mu))}{\partial \theta} - \frac{\partial C_p(s_p^*(\theta, \mu))}{\partial \theta} = -C_p(s_p^*(\theta, \mu)) - \theta \frac{\partial C_p(s_p^*(\theta, \mu))}{\partial \theta} < 0$$

Thus, the net social welfare of the exporting country $SW_1(s_p^*(\theta, \mu)) - C_p(s_p^*(\theta, \mu))$ is decreasing in θ . □

Proof of Proposition 4 From Eq. (9), defining the social welfare of the foreign country, we compare the social welfare in the presence of the political contribution with the one in the absence of the contribution as:

$$\begin{aligned}
 & SW_2(s_p^*(\theta, \mu)) - SW_2(s_c^*(\mu)) \\
 &= \frac{a^2(\theta - 1)(11 - 4\mu)^2(121 - 72\mu)(20\mu(1331 + 8(5 - 6\mu)\mu) - \theta(121 - 72\mu)(121 - 8\mu(7 + 2\mu)))}{8(121 + 72\mu)^2(363 - 132\mu - 2\theta(121 - 72\mu))^2} > 0
 \end{aligned}$$

Then, we examine how the political parameter affects the social welfare of the importing country as:

$$\begin{aligned}
 \frac{\partial SW_2(s_p^*(\theta, \mu))}{\partial \theta} &= \underbrace{\frac{\partial CS_2(s_p^*(\theta, \mu))}{\partial \theta}}_{+} + \underbrace{\frac{\partial PS_2(s_p^*(\theta, \mu))}{\partial \theta}}_{-} + \underbrace{\frac{\partial GR_2(s_p^*(\theta, \mu))}{\partial \theta}}_{+} \\
 &= \frac{a^2(11 - 4\mu)^2(121 - 72\mu)(363 - 16\mu(23 + \mu) + 4\theta(121 - 72\mu))}{8(363 - 132\mu - 2\theta(121 - 72\mu))^3} > 0.
 \end{aligned}$$

□

Proof of Proposition 5 $\partial s_p^*(\theta, \mu) / \partial \mu < 0$ and $\partial f(s_p^*(\theta, \mu)) / \partial \mu < 0$, $|\partial s_p^*(\theta, \mu) / \partial \mu| > |\partial f(s_p^*(\theta, \mu)) / \partial \mu|$.

In addition, $\partial s_p^*(\theta, \mu) / \partial \mu \Big|_{\mu=1} > \partial f(s_p^*(\theta, \mu)) / \partial \mu \Big|_{\mu=1}$. Therefore, $s_p^*(\theta, \mu) > f(s_p^*(\theta, \mu))$. □

Appendix C: the strategic interaction and the welfare loss due to the politically biased subsidies

The politically biased strategic trade policies were diagnosed as worsening social welfare mainly because of the increase in the socially wasteful expenditure on the political contribution in the earlier literature including Kagitani (2009). Even when the political contribution is considered to be a simple transfer of the income from the corporate sector to the government sector, the politically biased trade policies would worsen the social welfare by means of price distortion, as demonstrated by Grossman and Helpman (1994). The introduction of the limited verifiability of a hidden subsidy in this paper enables the theoretical evaluation of the increasing international tensions over the hidden subsidies to the export industries with complicated vertical production processes.

Kagitani (2009) focused on the welfare effect of the different patterns of the oligopolistic competition under the political economic structure of trade policies without considering the strategic interactions initiated by the importing country's subsidy–countervailing measures. This paper, on the other hand, examines the strategic interactions between trading countries by introducing subsidy–countervailing measures of the importing country, which depend on the probabilistic features of subsidy verifiability. The limited verifiability of the hidden subsidies helped to inflate strategic subsidies via the increased amount of equilibrium political contributions. In that context, the limited verifiability of the subsidies aggravates the distortion caused by the politically biased strategic trade policies.

Another feature of this study that was not considered in the earlier literature, including Kagitani (2009), is examining how the politically biased strategic trade policies affect the importing country's welfare. By means of this study, we provide another answer to the question of how the current WTO subsidy–countervailing rules might work properly to fully offset the prohibited export subsidies. We show that the politically biased export subsidies might improve the consumer surplus of the importing country significantly, reducing the importing country's policy incentive to fully countervail the subsidies. In addition, we share the same feature with Grossman and Helpman (1994), in that a single monopoly lobby extracts all the rents, as defined in the following binding participation condition of the policymaker:

$$SW_1(s) + (\theta - 1)C_p \geq SW_1^*$$

If we substitute the binding participation condition of the policymaker for the objective function of the single monopoly lobby, the equilibrium subsidy is supposed to satisfy the following first-order condition of the single lobby, which extracts all the rents:

$$(1 - \mu) \frac{dE[\pi_{1n}(s)]}{ds} + \mu \frac{dE[\pi_{1v}(s)]}{ds} + \frac{1}{\theta - 1} \frac{dSW_1(s)}{ds} = 0$$

The equilibrium subsidy derived from the above first-order condition shows that the lower verifiability of the hidden subsidy, represented by the lower value of μ , increases

the socially wasteful political contributions, which distorts the subsidy levels upward and eventually reduces the social welfare of the exporting country that provides more politically biased subsidies.

The introduction of the strategic response of the importing by means of a countervailing duty, which is dependent on the limited verifiability of the subsidy because of the complicated vertically fragmented production processes, is a novel feature of this study that was not tried in the earlier literature, including Kagitani (2009). This new approach produced a strong policy implication emphasizing the importance of improving policy transparency in order to increase the verifiability of the hidden subsidies.

Moreover, to focus on the strategic effects of politically biased export subsidies facing the possible countervailing measures of the importing country, this paper considers consumer surplus only in the importing country. The change in the producer surplus of the exporting country is composed of two parts: (1) increased profits of the upstream firm because of the direct effect of cost reduction by the subsidies, and (2) increased profits of the downstream firm because of the decreased price of the intermediate inputs, which can be interpreted also as the transfer of the corporate surplus from the importing country.

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